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भूकृत्रिम — हार्ड कवच प्रणाली में स्थायी क्षरण नियंत्रण के लिए भूवस्त्रादि की स्थापना के लिए दिशानिर्देश

Geosynthetics — Guidelines for Installation of Geotextile for Permanent Erosion Control in Hard Armor Systems

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भारतीय मानक ब्यूरो
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Geosynthetics Sectional Committee, TXD 30

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Geosynthetics Sectional Committee had been approved by the Textile Division Council.

Soil banks or slopes exposed to constant concentrated flows, currents or waves cannot support vegetation and thus need to be protected from erosion by hard armor systems. These systems include fabric formed revetments, gabions, articulating concrete blocks and riprap. In a hard armor system, water can seep in or out of the bank or slope and gradually carries soil particles with it creating voids causing loss of armor support over time called piping and thus culminates in shifting, rolling or other instability in the armor system. The traditional system may use controlled thickness filter layers of graded sand which is very costly and difficult to construct especially on steep slopes.

Geotextiles with specific hydraulic and soil retention properties to complement the soil needing protection can be used as standard filter layers for hard armor systems as these can be installed with ease on slopes even under water and are cost effective. Depending upon the gradation of the bank soil, either a non-woven or a woven geotextile can be selected and used beneath hard armor system in an erosive environment.

The primary function of geotextile in permanent erosion control applications is filtration. Geotextile filtration properties are a function of site hydraulic conditions and the *in-situ* soil gradation, density, and plasticity.

Survivability of geotextiles is very important from the viewpoint of their long-term durability and is defined as resistance to mechanical damage during construction and initial operation. The ability of a geotextile for permanent erosion control to survive installation and associated pressures during service shall be assured if it is to perform as designed. Installation damage to a geotextile is a function of the following:

a) Geotextile thickness,
b) Compactive effort and fill thickness,
c) Grain size distribution of backfill,
d) Angularity of backfill,
e) Polymer used in the manufacture of geotextile, and
f) Geotextile manufacturing process.

Geotexiles are mainly made from polyester (PET) or polypropylene (PP). PP is lighter than water, strong and very durable. PET is heavier than water, has excellent strength and creep properties, and is compatible with most common soil environments. Geotextiles are mainly of two types, namely, woven and non-woven geotextiles. Knitted and stitch bonded geotextiles are occasionally used in the manufacture of specialty products. Non-woven geotextiles are highly desirable for subsurface in planer drainage, and erosion control applications as well as, for road stabilization over wet moisture sensitive soils. Out of woven geotextiles, slit film fabrics geotextiles are commonly used for sediment control, that is silt fence and road stabilization applications but are poor choices for subsurface drainage and erosion control applications. Monofilament woven geotextiles have better permeability making them suitable for certain drainage and erosion control applications. High strength multifilament woven geotextiles are primarily used in reinforcement applications.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GEOSYNTHETICS — GUIDELINES FOR INSTALLATION OF GEOTEXTILE FOR PERMANENT EROSION CONTROL IN HARD ARMOR SYSTEMS

1 SCOPE

1.1 This standard prescribes guidelines for installation of geotextile for permanent erosion control in hard armor systems. It does not apply to other types of geosynthetic erosion control materials such as turf reinforcement mats.

2 SURFACE PREPARATION

The slope or bank shall be graded smoothly and be free from obstructions, depressions and soft pockets of material by clearing vegetation, large stones, limbs, stumps, trees, brush, roots and other debris. The surface shall be compacted. Any pockets of soft soil shall be removed and replaced with compacted earth material to provide a consistently uniform and strong, stable surface. Remove all sharp objects and large stones.

NOTE — Excessive soft spots or voids may be unsuitable for geosynthetic installation.

3 DEPLOYMENT OF THE GEOSYNTHETIC

3.1 Unroll the geosynthetic directly on the prepared soil. It shall not be exposed to ultra-violet (UV) deterioration for more than one week in case of untreated geotextiles and for more than 30 days in case of UV protected and low UV susceptible polymer geotextile. The geosynthetic shall be placed parallel to small ditch and stream alignments and perpendicular to lake or ocean shores to minimize the exposure of the geosynthetic to current or wave uplift.

3.2 Secure the geosynthetic in place using 15 to 45 cm steel pins, pointed at one end and fitted with 40 mm metal washer at the other end or staples. Longer pins are advisable for use in loose soils. The pin spacing dependant on slope shall be as follows:

Slope (1)	*Pin Spacing,* mm (2)
Steeper than 1 V over 3 H	600
1 V on 3 H to 1 V on 4 H	900
Flatter than 1 V on 4 H	1 500

3.3 Do not drag the geotextile or mishandle in any way. Loosely place the geotextile without wrinkles or folds and with no void spaces between the geotextile and the surface so that it does not tear. Lap or sew the geotextile at the ends and sides of adjoining sheets as specified by the construction drawings or by the Engineer. Successive sheets of geotextiles shall be overlapped a minimum of 500 mm with the upstream sheet overlapping the downstream sheet in order to provide continuous erosion protection.

3.4 When used for wave attack or cut and fill slope protection, the geotextile shall be placed vertically down the slope and the upslope strips shall cover the downslope strips. In case of slopes, place the geotextile with the machine direction oriented up-down. Stagger the overlaps at the end of the strips at least 1 500 mm. The geotextile shall be anchored at its terminal ends to prevent uplift or undermining. For this purpose, key trenches and aprons are used at the crest and toe of the slope.

3.5 When used for stream bank protection, where currents acting parallel to the bank are the principal erosion forces, place the geotextile with the machine direction in the direction of the anticipated waterflow. The upper strips of the geotextile shall overlap the lower strips.

3.6 On curves, the geosynthetic may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of fill or rock.

3.7 If geotextiles are placed under water or in areas where water will flow, a geotextile material of a density greater than that of water shall be selected. The geotextile may be placed with the machine direction parallel to the direction of water flow. Overlap sheets such that upstream sheet is placed over the top of the downstream sheet. Adequately secure the geotextile to prevent slippage. As the geotextile is placed under water, place the backfill material on it to the required thickness. Do not place the geotextile more than 15 m ahead of the specified cover material.

3.8 When field sewn seams are required, sew field seams with polymeric thread consisting of polypropylene or polyester and as resistant to deterioration as the geotextile being sewn. Use a colour of thread that contrasts with the geotextile being sewn so that the stitches are exposed for inspection when the geotextile is placed. Seams shall meet the testing requirements given below:

a) Use two rows of lock type stitching, to make the seams. The two rows of stitching shall be 12 mm apart with a tolerance of ± 6 mm and not cross except for restitching.

b) The minimum seam allowance (the minimum distance from the edge of geotextile to the nearest stitching shall be:

Flat or Prayer Seam, Type SSa-1	40 mm
"J" Seam, Type SSn-1	25 mm
Butterfly-folded Seam, Type SSd-1	25 mm

c) Obtain the geotextile manufacturer's recommendation for the type of seam and stitch to be used. If the contractor does not obtain and provide this information, use a "J" seam with at least three stitches per 25 mm. The flat or prayer seam may be used for repair or damaged in-place geotextile.

3.9 Adjacent geotextile strips shall have a minimum overlap of 300 mm along the edges and at the ends of the rolls. Specific application may require additional overlaps. Sewing, stapling, heat welding, or glueing adjacent panels, either in the factory or on site are preffered to lapping only.

3.10 Prior to covering, the geosynthetic shall be inspected by a certified inspector of the Engineer to ensure that the geosynthetic has not been damaged during installation. Damaged geosynthetic shall be repaired or replaced immediately. In case the geotextile is damaged during installation, or aggregate placement, a geotextile patch shall be placed over the damaged area extending beyond the damaged area a distance of 300 mm, or the specified seam overlap, whichever is greater.

3.11 The geotextile shall be laid at the proper elevation and alignment as shown on the construction drawings. The geotextile shall be installed in accordance with the installation guidelines provided by the manufacturer or as directed by the Engineer. The geotextile may be temporarily secured in place with ties, staples, pins, sand bags or backfill as required by fill properties, fill placement procedures or weather conditions or as directed by the engineer.

3.12 Place, spread, and compact granular fill material in such a manner that minimizes the development of wrinkles in or movement of the geotextile.

4 PLACEMENT OF THE COVER MATERIAL

The cover material such as armor, riprap or concrete blocks shall be placed in accordance with accepted practices. For sloped surfaces, placement of the cover material shall start from the base of the slope moving upward and preferably from the centre outward to limit any partial movement of soil because of sliding. The drop height shall be held to a minimum and care shall be exercised to avoid damage to the geosynthetic. If a drop height greater than 100 cm is anticipated, a heavier, more durable geosynthetic shall be required.

5 PROTECTION OF GEOTEXTILE

5.1 Protect the geotextile at all times from ultraviolet (UV) rays, contamination by surface runoff and construction activities. Traffic or construction equipment shall not be permitted directly on the geotextile except as directed.

5.2 During installation, cover the geotextile with specified cover material as soon as possible. Do not leave in uncovered condition for more than five days, except when used with temporary, wrap faced, mechanically stabilized earth walls and asphalt overlays.

5.3 Place the cover material on the geotextile in such a manner that the geotextile is not torn, punctured or shifted. Do not end dumping cover material directly on geotextiles other than riprap geotextile.

6 INSPECTION

6.1 The owner or owner's representative may randomly inspect geotextile before, during and after (using test pits) installation.

6.2 Any damaged or defective geotextile (that is frayed coating, separated junctions, separated layers, tears, etc) shall be repaired/replaced in accordance with **7**.

7 DAMAGE REPAIR

7.1 Repair or replace all torn, punctured or contaminated geotextiles during placement of the armor. Clear the damaged area, plus an additional 1 m around it, of all armor material and cover it with a patch of the specified geotextile that extends 1 m beyond the perimeter of damage. The patch should be placed beneath the damaged geotextile and pinned. Then carefully replace the armor material.

7.2 Where geotextile seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the plans or special provisions, as directed below:

a) *Embankment Geotextile* — Construct embankment stabilization according to details shown on the plans. Place the geotextile layers so that the geotextile machine direction is transverse to the embankment centerline.

Spread the geotextile so that all slack and wrinkles are eliminated. Construct embankment in uniform layers.

b) *Riprap Geotextile* — Place geotextile behind and beneath riprap, buttresses, inlays, shear keys and erosion control applications according to the details shown. Demonstrate to the satisfaction of the Engineer that the combination of the rock-fill drop height and the thickness of any aggregate cushion, when specified or required, is adequate to prevent puncturing or damaging the geotextile when placing the riprap or stone embankment material, the following limits shall apply:

Maximum Drop Height, m

Size of Rock (1)	*Onto Geotextile Material* (2)	*Onto an Aggregate Cushion Blanket* (3)
Greater than 90 kg	0	1
90 kg or less	1	1

After placing the riprap, backfill all voids in the riprap face so that the geotextile is completely covered and not visible.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Geosynthetics Sectional Committee, TX 30

Organization	*Representative(s)*
The Bombay Textile Research Association, Mumbai	Dr A. N. Desai (***Chairman***) Shri V. K. Patil (*Alternate*)
Business Coordination House, New Delhi	Shri Samir Gupta Shrimati Ritika Gupta (*Alternate*)
Central Road Research Institute, New Delhi	Shri Sudhir Mathur Shri Jai Bahagwan (*Alternate*)
Central Soil and Materials Research Station, New Delhi	Shri Nripendra Kumar Shri Manish Gupta (*Alternate*)
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